

the use of digitalis and the other heart tonics and diffusible stimulants will often be necessary. *Careful and constant attention is absolutely necessary. Many patients die who might be saved by the timely administration of a stimulant in threatened heart failure.* Antifebrin has also been used with a certain amount of success in the City Hospital.

In conclusion, I would publicly express my thanks to Dr. Dalton, Superintendent of the City Hospital, who has placed the large material of that hospital so freely at my disposal, and also to the physicians in attendance at that institution during the past two years. Their interest in the investigations of this disease, their post-mortem examinations, and their confirmation of the symptoms and physical signs as embraced in this paper will strengthen the views I have advanced. My thanks are also due to Dr. L. Bremer, Professor of Physiology and Bacteriology in the Missouri Medical College, who has assisted at most of the post-mortems.

NOTES ON SOME OF THE RELATIONS OF UNDERGROUND AIR AND WATER TO QUESTIONS OF PUBLIC HEALTH.

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IN the model series of by-laws for the regulation of new streets and buildings, prepared by the English Local Government Board for the guidance of sanitary authorities, are two clauses of which the express object is to secure wholesome sites for dwelling-houses.

One of these clauses provides that :

"A person who shall erect a new building shall not construct any foundation of such building upon any site which shall have been filled up with any material impregnated with any animal or vegetable matter, or upon which any such matter may have been deposited, unless and until such matter shall have been properly removed, by excavation or otherwise, from such site."

The other clause is as follows :

"Every person who shall erect a new dwelling-house shall cause the whole ground surface or site of such building to be properly asphalted or covered with a layer of good cement concrete, rammed solid, at least *six inches* thick."

The first provision aims at preventing the danger obviously arising from the erection of houses upon sites which have been made by the obnoxious practice of "tipping" or filling up clay pits and inequalities of the ground with house and other organic refuse prone to putrefaction or decay, while the second has for its special object the protection of the household from the risks to health involved in the passage of dampness and foul air from the foundations into the interior of a dwelling.

It is unfortunate for the efficiency of local administration that sanitary authorities, large and small, have been slow to recognize the importance of these provisions, which, too generally, they have either neglected to adopt, or, having adopted, shown by an arbitrary and inconsistent application, their misapprehension of the real object in view. This is particularly the case in regard to the second of these essentially preventive measures against disease. An authority adopts the by-law and proceeds to enforce it in houses built upon an impervious clay subsoil, but waives it in those built on gravel or sand, in accordance with popular notions as to the dampness of the one and the dryness of the other, thus failing to appreciate the fact, less obvious than the dampness of a clay soil, that porous sands in general may, by reason of this very quality of porosity, give rise on occasion to special and even more serious dangers to health.

The influence of soil in its relation to health and disease is one of the oldest and has always been one of the most prominent subjects of medical disquisition, from a time even before Hippocrates, in whose works it is dealt with as one of the material conditions affecting life.¹

At one or another epoch, so-called telluric influences have been successively invoked to account for all that was inscrutable or especially disastrous. Such for instance was the explanation held by leading physicians of the age as sufficient to account for the epidemic visitations during the fourteenth century of the pestilence known as the Great Mortality or Black Death—the disease which by its ravages in Florence gave Boccaccio the narrative of the *Decameron*: of the Sweating Sickness in its recurring epidemics from nearly the end of the fifteenth until the middle of the sixteenth century, and of the later visitations of the Plague.

But in these, as well as many other instances outside the class of epidemic diseases, the question of cause remained merely a subject for curious and bewildering speculation, which continued to serve the purpose of the science of the times with little change beyond what might be incidental to succeeding phases of thought down to quite recent years.

It is entirely a result of the modern progress of clinical medicine and as a direct consequence of more accurate diagnosis and identification of disease, that inquiry into causation has reached the precision of method it follows to-day. In relation to our present subject, *bahn brechende* (to employ a felicitous German word) observations of Pettenkofer upon the connection between outbreaks of enteric or typhoid fever and changes in the soil associated with variations in the level of the ground water, may be claimed as the starting-point of the interesting series of investigations

¹ Hippocrates: Lib. de aere, aquis et locis.

which have since been carried on into the influence of meteorological and topographical conditions in determining the prevalence of disease.

Although later inquiry into outbreaks of enteric fever or cholera has not confirmed the importance attached by Pettenkofer to changes in the soil as a *general* condition of the spread of these diseases, the weight of evidence being conclusively in favor of other agencies, as contaminated drinking-water and the air of infected sewers, yet the possibility of the influence of such changes as a localizing condition, which the greater frequency of other agencies may cause to be overlooked, ought not to be lost sight of. This remark applies especially in those outbreaks of a peculiarly circumscribed character apparently unassociated with water or sewer infection, where, in the absence of known introduction of disease, the observer is inclined to assume a genesis from some coincident insanitary circumstance. But, apart from the etiological value of this theory, Pettenkofer's distinctive merit has been to direct attention to the exact investigation of the local and seasonal relations of epidemic disease, while he was one of the first to recognize and to stimulate observations, such as those of Professor Fodor, of Buda-Pesth,¹ carried on continuously and systematically over a series of years into the intricate problems presented by this wide field of epidemiology.

The physical circumstances of soils largely determine the facility and area of distribution of the air and water contained within their pores, a loose and open soil giving opportunity for considerable freedom of movement. Air under these conditions readily responds to the laws of expansion of gases, changes of temperature and of barometric pressure, and mingles directly and by diffusion with the upper atmosphere, with which it is in effect continuous.

The action of wind upon the surface has been shown to set in motion the subterranean atmosphere, and the same result is brought about by fluctuations in the level of the ground water below it.

In well-paved towns, where the open spaces about the houses are flagged or cemented but the sites of the houses themselves are unprotected and formed merely by the natural surface, the ground air has then its chief outlet into the houses, its ascent being materially aided by the warmer temperature and the aspirating action or suction of the house fires. Where cellars or basements exist, with walls in immediate contact with the soil, instead of being cut off by an outer open area, this effect is enhanced, as ordinary brick or stone and mortar walls allow very considerable transpiration of air. Fodor has shown that the penetration of ground air into house basements takes place with marked intensity in comparison with houses merely built upon the ground level. In porous

¹ Hygienische Untersuchungen über Luft, Boden und Wasser, insbesondere auf ihre Beziehungen zu den Epidemischen Krankheiten.

soils the ground air may be drawn for considerable distances in a horizontal as well as vertical direction, bringing with it impurities and effluvia from quite unsuspected localities.

The underground or subsoil water as distinguished from mere moisture or humidity exists at varying depths from the surface, determined by the existence of underlying impervious layers holding it up and upon facility of outlet. The flow of rivers and conditions of rainfall bring about fluctuations of level in this subterranean sheet of water. In a porous soil the movement of water may be perceptible over a considerable area.

Förster, of Breslau, cites an instance where, after construction of a gasometer, the wells of the locality became impregnated with the smell of coal gas. At first it was conjectured that the gas mains were leaky; but it was noticed that the water of the gasometer tank fell and had to be renewed from time to time. This tank was cemented and made watertight and the wells meanwhile pumped out and cleansed, with the result that no further leakage of the gasometer or contamination of the wells took place. The distance from the one to the other was upward of 560 paces. Other instances might be given, but this may suffice to show the extent of movement of underground water and at the same time the risk of pollution to local sources of water supply.

The moisture or dampness of a soil is dependent on the movements, including evaporation and capillary attraction, of the underground water, and also upon rainfall. When the conditions of water-logging are such that the soil is constantly moist or wet, then, whether it be clay or gravel, the effect will be similar, and evaporation, which is known to be more rapid from a porous solid than from the surface of a sheet of water, is continuously going on and causes those sensations of coldness and rawness which are familiar characteristics of such soils.

Where organic impurity exists, the process of oxidation on the one hand or putrefaction on the other will be determined by the greater or less amount of air and moisture present and the conditions favorable to bacterial life. For it has been shown by recent investigations on this subject that the processes at one time attributed to chemical energy alone are now largely influenced by microorganisms of one or another kind. The process of nitrification or production of nitrates in the soil, at one time regarded as a result of chemical oxidation, has been found to be brought about by the action of a bacterium. When, however, under limited access of air putrefaction occurs, different species of bacteria are concerned in the process. Sandy or gravelly soils from their porous character are more favorable to oxidation and rapid decay than clay or close soils. And the significance of this to health is obviously that a soil which oxidizes quickly will not retain hurtful, and it may be infectious, matters, which by a soil of opposite character may be retained for an

unknown length of time, and, on opportunity, be communicated to the air or water.

From these considerations it follows that a well-aërated soil affording unobstructed movement to the air possesses greater power of getting rid of its organic impurities than one of an opposite quality, and is in the same degree less likely to be a nidus for the germs of disease.

The source of the ground air is primarily the atmosphere at the surface. Penetrating to depths dependent upon freedom of access and level of the ground water, the chemical constitution of the air becomes changed, the most remarkable result being the largely increased proportion of carbonic acid. The richness of ground air in this gas was first ascertained by the distinguished French chemist, Boussingault, in his researches into agricultural chemistry, who found that the amount reached 97.4 per 1000 volumes, the proportion of carbonic acid in the atmosphere being only 3 or 4 per 10,000 volumes.

Later experiments by Pettenkofer and others have confirmed these observations, the amount being found to vary with season, locality, opportunity for decomposition of organic substances, and to increase with depth from the surface. Thus Fodor found it to be 101.9 per 1000 at the depth of one metre (39 inches) and 376.1 at a depth of 4 metres (13 feet). Thus the carbonic acid of the ground air is apt to accumulate in wells, rendering the air irrespirable. It may be taken as a measure of the impurity of the ground air, and in soils of similar characteristics of density affords a corresponding indication of the changes going on. In compact soils the amount of carbonic acid is comparatively greater than in porous soils, even where the latter are less pure, a result which is dependent upon the less facilities for ventilation and circulation of air such soils possess. The influence of the ground air upon the atmosphere has been shown by Fodor to be remarkable and to a large extent unexpected, but to this interesting part of the subject the limits of this paper permit only incidental reference. Observations of the amount of carbonic acid in the atmosphere have shown that while the amount is pretty constant within narrow limits, variations of a minute but well-marked order occur throughout the year. He found the amount lowest in winter, increasing in spring, falling slightly in the summer months and reaching its maximum in autumn, September to November.

But there are also daily oscillations in the amount of carbonic acid, which are most considerable in autumn, the end of spring, and the beginning of summer, the greatest constancy being observed in winter and early spring.

At night the amount of carbonic acid in the air was greater than during the day in autumn, but less in spring. Rainfall was found to diminish the amount of carbonic acid, but whilst this effect was permanent in winter, in summer it was followed shortly afterwards by a marked

increase. On the other hand, frost increased, then diminished, the amount of carbonic acid.

Lastly, in relation to atmospheric pressure, Fodor found that in winter the carbonic acid increased with increased barometric pressure and *vice versa*, while in summer the converse was observed, the carbonic acid increasing with diminished pressure.

His later observations prove that not only the whole of the changes are dependent upon the ground air, but that the ground air is the chief source of the carbonic acid in the atmosphere.

He found the lowest stratum of the air next the ground to contain more carbonic acid than the higher strata, and that the fluctuations of the carbonic acid in the lower stratum according to season and the like, preceded similar changes in the higher regions.

The soil was found also to possess the property of absorbing and therefore diminishing the amount of carbonic acid in the atmosphere, the lower stratum becoming poor in amount and notably in rainy days, in spring, and during thaw, thus explaining some of the changes already described.

Depending in the first instance upon the decomposition of organic substances within the soil, and varying in amount with the greater or less degree of impurity, the carbonic acid thus escaping into the air shows the constant ascent and diffusion of the ground air and that this is greater in autumn and summer. This ascent of ground air into the atmosphere is accompanied by a corresponding ascent into dwelling-houses, greater at night than in the daytime on account of the greater warmth and rarefaction of the ground air, during these seasons of the year. From these considerations Fodor concludes that the atmospheric carbonic acid is in chief part a product of the changes going on in the soil, and in its variations is an index of the rising of the ground air and the extent of its pollution by processes of decay. The question remains unanswered how far the ground air and its escape into the upper atmosphere influence the development and spread of infectious diseases.

The ascensional force of air streaming from the ground has been shown to be considerable, and to be capable not only of conveying gaseous or volatile substances and effluvia upward, but also particulate matter bearing microorganisms. To what extent microorganisms thrive in the deeper layers of the soil has not yet been determined. In some recent observations in Germany upon bacteria in drinking-water it was found that by hard pumping of wells the bacteria almost completely disappeared, from which it was concluded that the deep-ground or spring water was nearly free from them, and that the source of their entrance into the well was from the air or upper layers of the soil. Observations as to the influence of season led to similar conclusions, the microorganisms increasing in number between April and October, after which they

became fewer in amount, their numbers running parallel to the temperature of the superficial layers of the soil.

But how far the soil may be the brooding-place of pathogenic bacteria; how far in relation to certain of the life-processes of such bacteria it may play the part of an intermediary host, is still unknown. The observations of Buchanan, in this country, and of Bowditch, in America, upon the undoubted influence of damp soil in causing consumption, the effects of marsh air in producing malarious and other paroxysmal fevers, and the general ill effects commonly observed to be exerted by an impure and undrained soil upon the health of persons living upon it, all point with more or less confirmation to the associated life-processes of lower organisms with those conditions of ground air, ground water, and organic change which, in their interaction and its results, constitute an unhealthy soil.

ON THE RELATION OF IMPETIGO HERPETIFORMIS (HEBRA
AND KAPOSÍ), TO DERMATITIS HERPETIFORMIS
(DUHRING).

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As there have been considerable discussion and some diversity of opinion as to the propriety of grouping impetigo herpetiformis under dermatitis herpetiformis, I desire briefly to present my reasons for having originally adopted this view. It may be well to premise my remarks with the statement that heretofore, in my several communications on this disease, I have confined my observations largely, if not exclusively, to the cutaneous manifestation—to the skin disease proper—with the idea mainly of calling attention to the multiform phases of the disease. The symptoms alone, it may be said, have up to the present time received attention; the equally, if not more, important subjects of etiology and pathology being for the time intentionally slighted. In all rare or obscure affections the eruption itself, including its history, symptoms, evolution and involution, is first to be considered. After these points have been determined upon, as far as the material at hand will permit of, the questions of the cause and nature of the disease naturally follow for investigation and discussion. In addition to the clinical memoranda and observations presented from time to time, I have sought to bring together into one group such previously reported cases, scattered throughout literature, and certain other allied forms of disease, as seemed to me might properly be included under one head. Circumstances have, for some time past, prevented me from con-